

**Comparison of particle-tracking and lumped-parameter age-distribution models for
evaluating vulnerability of production wells to contamination**

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**Tracer-tracer graphs and tracer-time graphs comparing measured and simulated
values of environmental tracers**

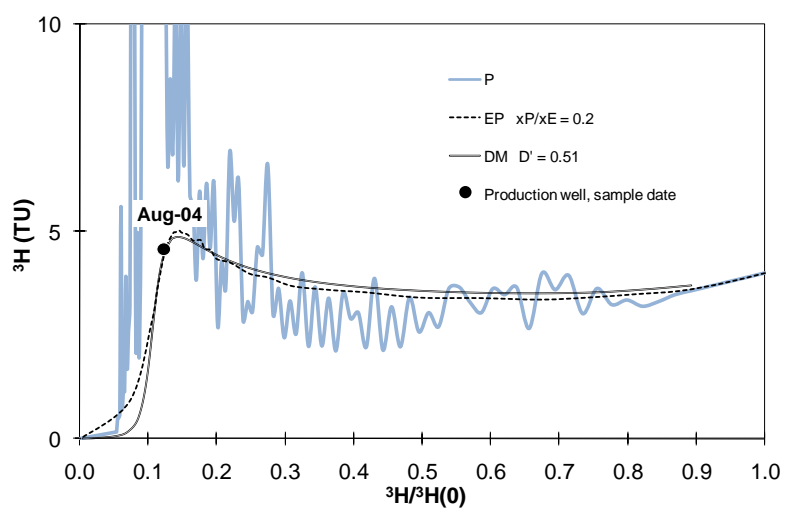
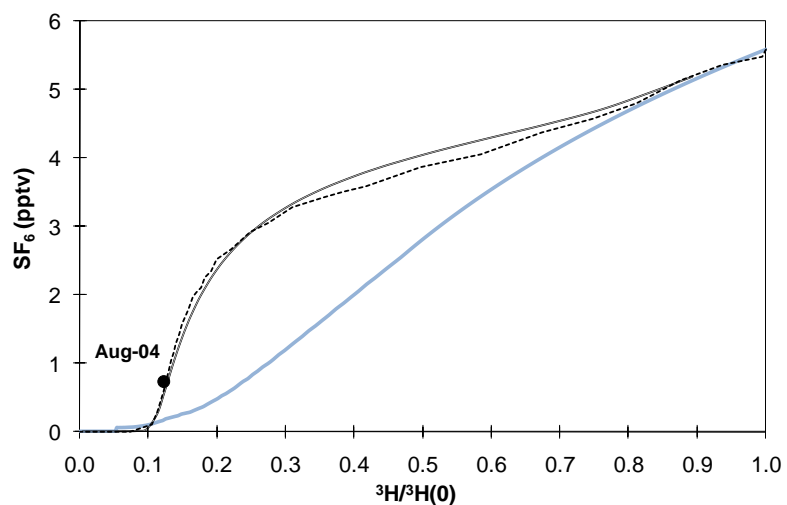
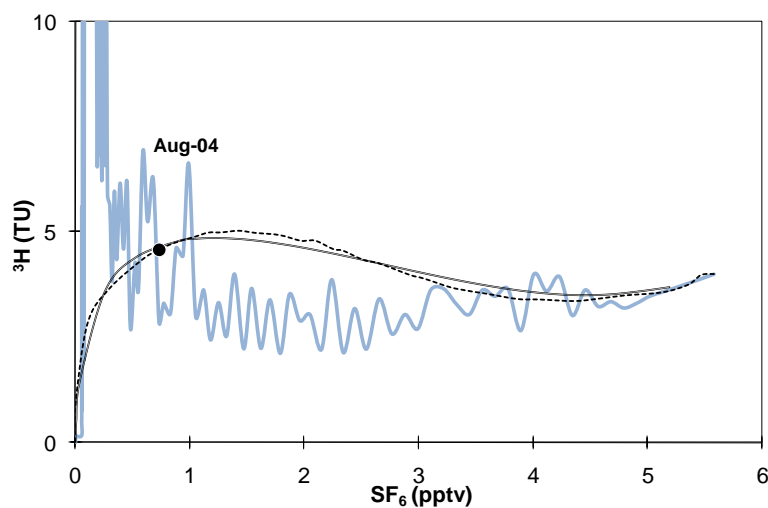


Fig. ESM1 Tracer-tracer graphs for the Modesto, California, production well completed in unconsolidated alluvial-fan sediments of the Central Valley aquifer system. Individual curves correspond to different models, where P is piston flow (no mixing), EP is exponential piston flow, and DM is dispersion (symbols explained in top graph). Model dates 2004.5 (mid-year)



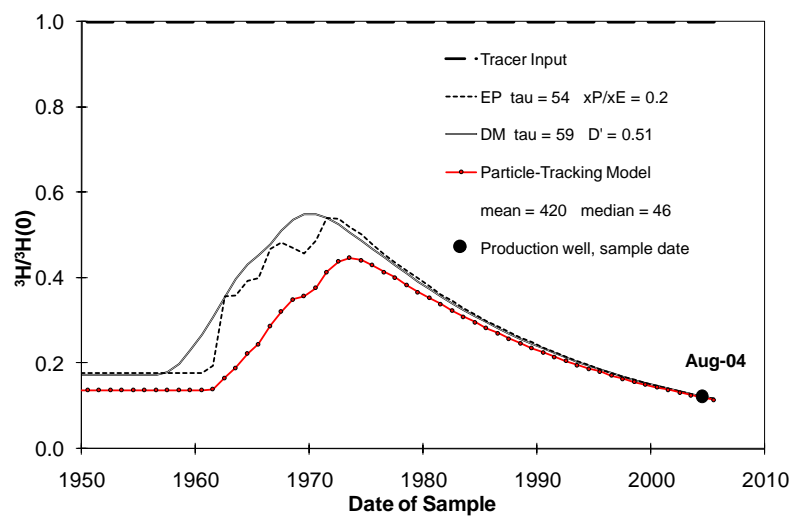
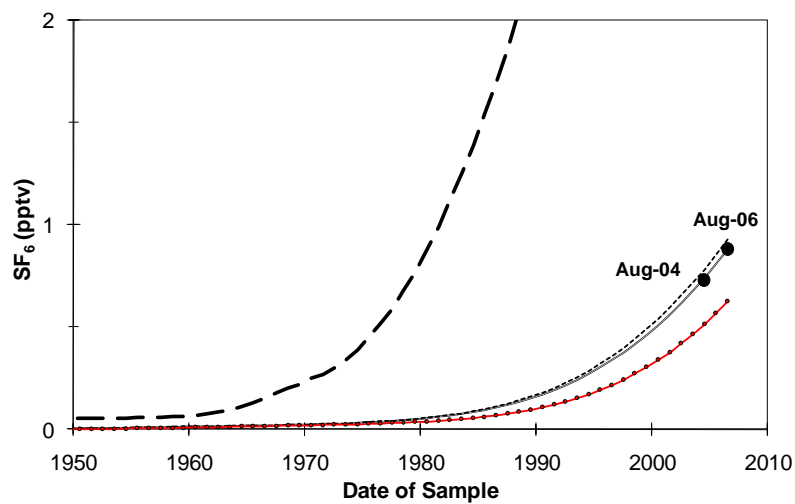
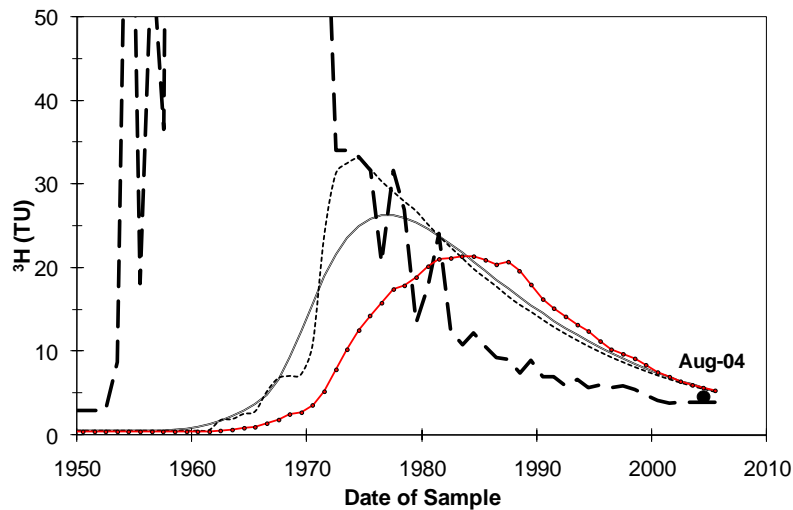


Fig. ESM2 Tracer-time graphs for the Modesto, California, production well completed in unconsolidated alluvial-fan sediments. Individual curves correspond to different models, where EP is exponential piston flow, DM is dispersion, and Particle-Tracking Model is three-dimensional groundwater-flow model with particle tracking (symbols explained in top graph)



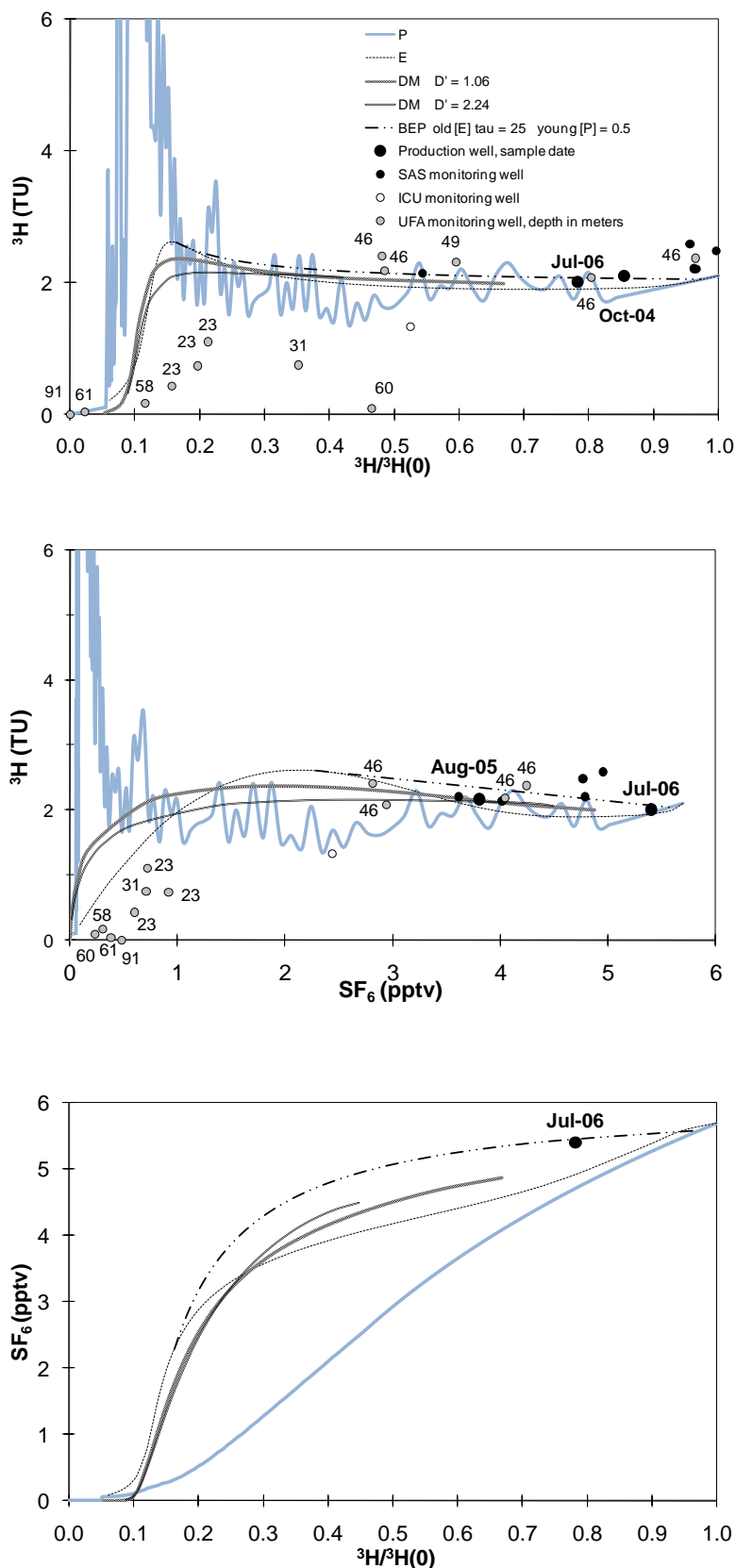


Fig. ESM3 Tracer-tracer graphs for the Tampa, Florida, production well completed in carbonate rocks of the Upper Floridan aquifer system (UFA), which is overlain by an intermediate confining unit (ICU) and surficial aquifer system (SAS). Individual curves correspond to different models, where P is piston flow (no mixing), E is exponential, DM is dispersion, and BEP is binary exponential and piston flow mix (symbols explained in top graph). All models should merge with each other in young samples, but some plotted curves were truncated because of calculation artifacts where numerical model time steps were large compared to mean ages. Model dates 2005. Monitoring well data are included on graphs for comparison purposes only and were not used to estimate parameter values for the lumped-parameter models

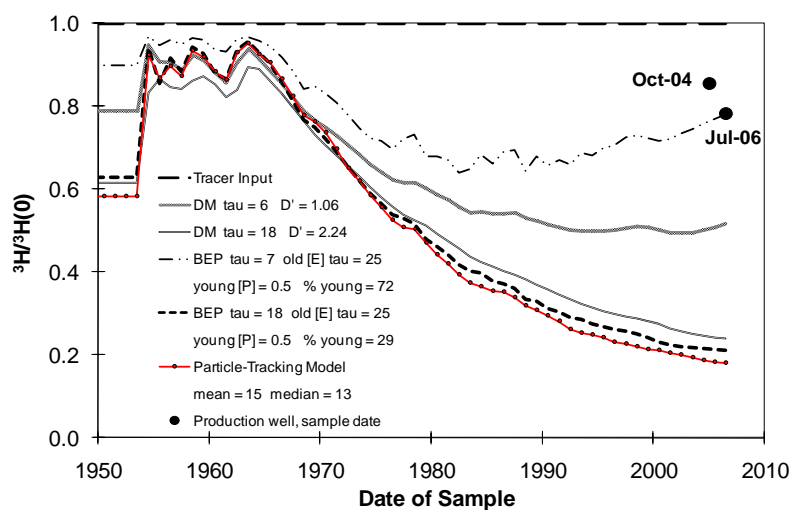
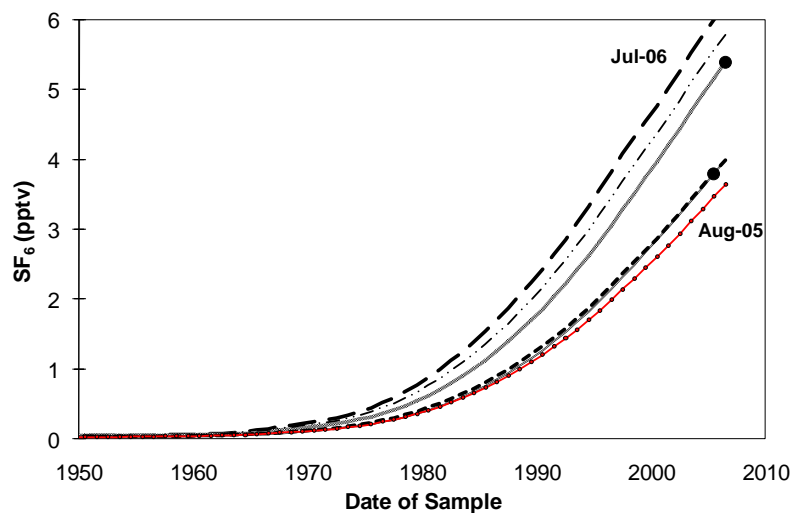
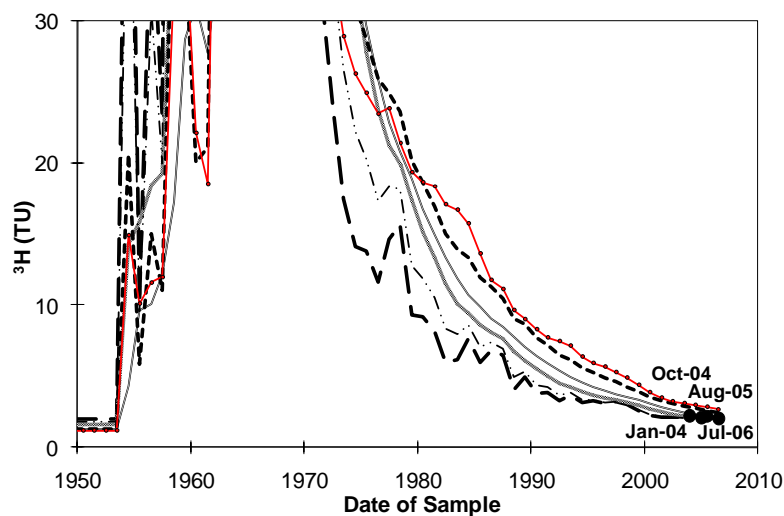


Fig. ESM4 Tracer-time graphs for the Tampa, Florida, production well completed in carbonate rocks. Individual curves correspond to different models, where DM is dispersion, BEP is binary exponential and piston-flow mix, and Particle-Tracking Model is three-dimensional groundwater-flow model with particle tracking (symbols explained in top graph)



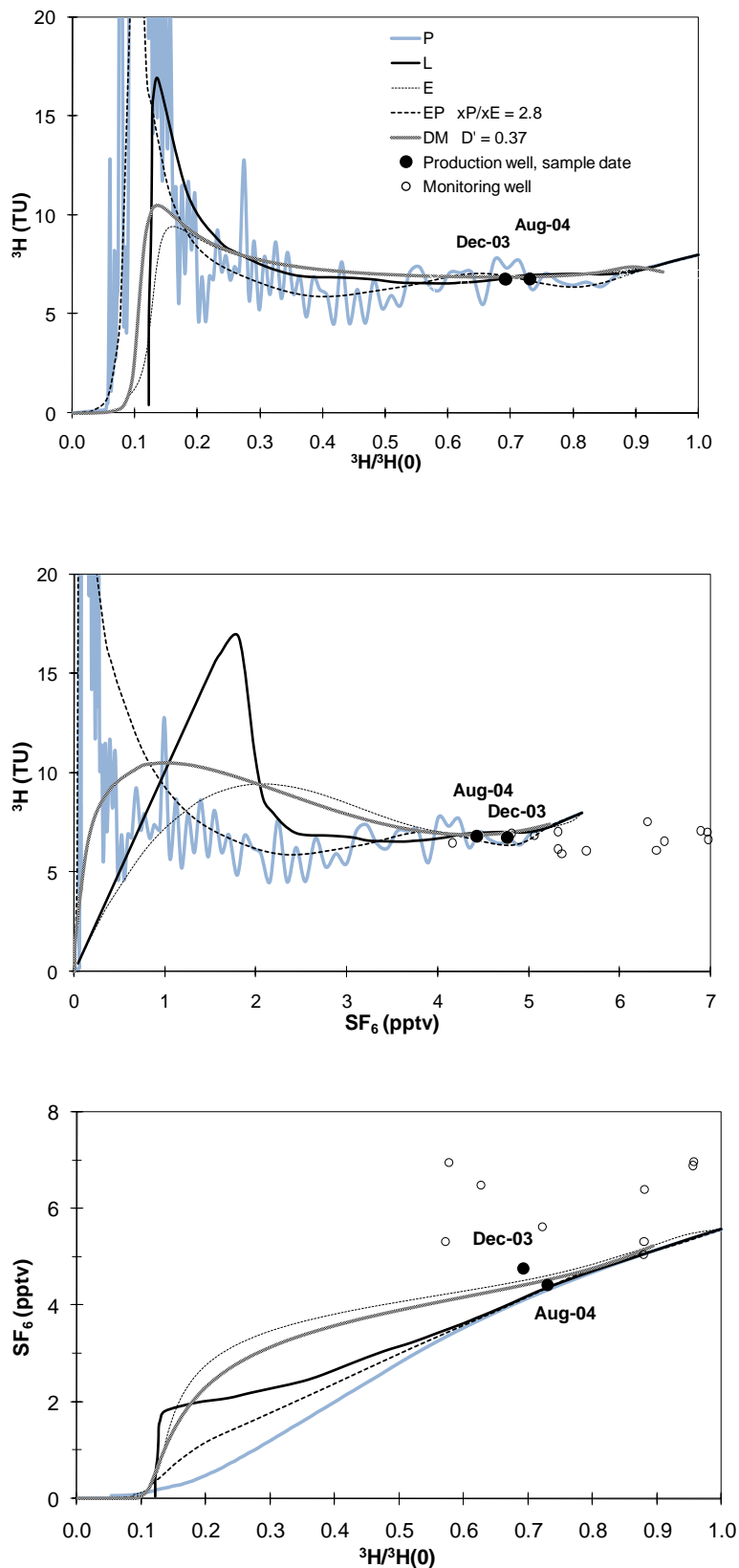


Fig. ESM5 Tracer-tracer graphs for the Woodbury, Connecticut, production well completed in unconsolidated valley-fill sediments of the Glacial aquifer system. Individual curves correspond to different models, where P is piston flow, L is linear, E is exponential, EP is exponential piston flow, and DM is dispersion (symbols explained in top graph). Model dates 2004.5 (mid-year). Monitoring well data are included on graphs for comparison purposes only and were not used to estimate parameter values for the lumped-parameter models

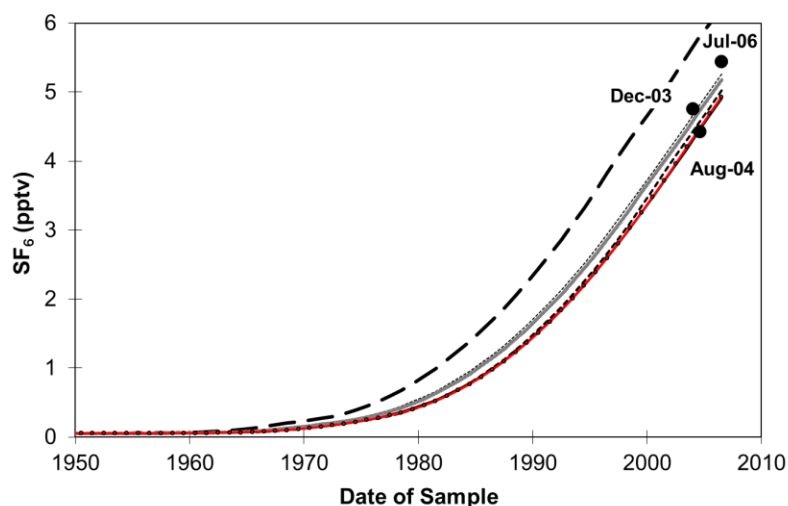
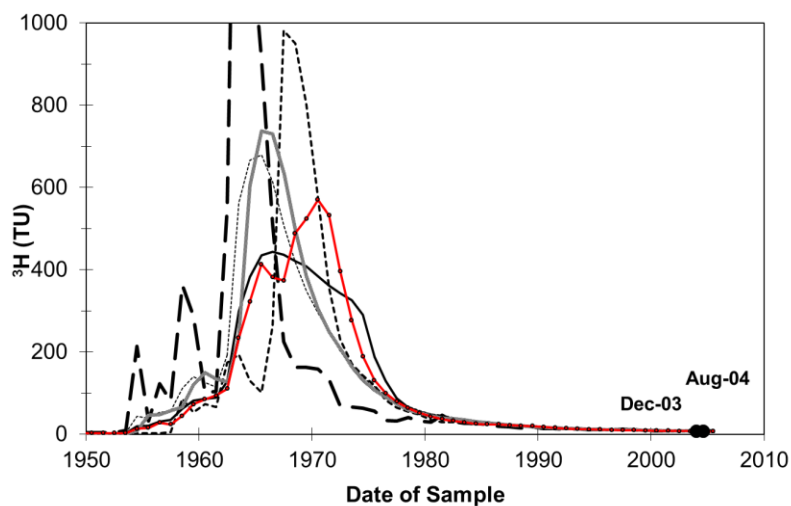
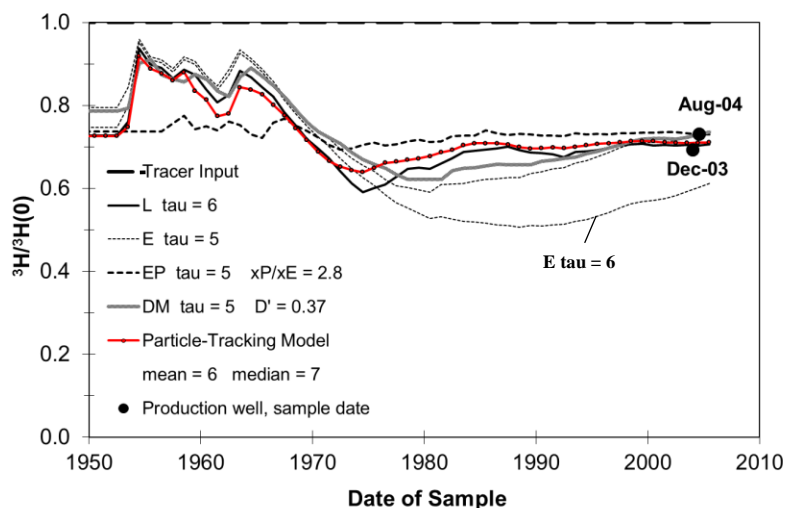


Fig. ESM6 Tracer-time graphs for the Woodbury, Connecticut, production well completed in unconsolidated valley-fill sediments. Individual curves correspond to different models, where L is linear, E is exponential, EP is exponential piston flow, DM is dispersion, and Particle-Tracking Model is three-dimensional groundwater-flow model with particle tracking (symbols explained in top graph). The curves for two E models ($\tau = 5$ and $\tau = 6$) are included in the top graph to illustrate the sensitivity of the age distribution results to model parameter values and the environmental tracer data used to estimate them. The E $\tau = 6$ curve is not included in the bottom two graphs

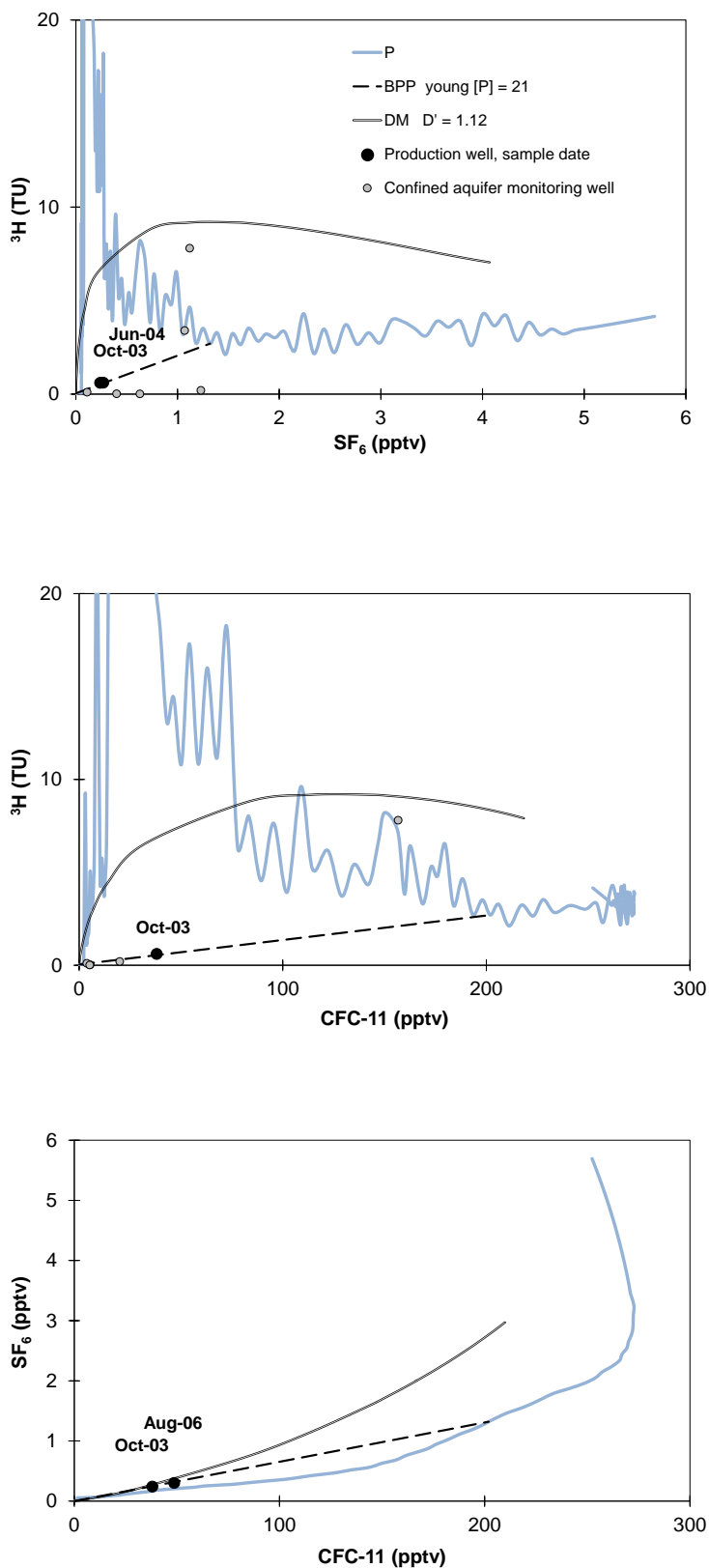


Fig. ESM7 Tracer-tracer graphs for the York, Nebraska, production well completed in layered, confined, unconsolidated sediments of the High Plains aquifer. Individual curves correspond to different models, where P is piston flow, BPP is binary piston flow and tracer-free mix, and DM is dispersion (symbols explained in top graph). All models should merge with each other in young samples, but some plotted curves were truncated because of calculation artifacts where numerical model time steps were large compared to mean ages. Model dates 2005. Monitoring well data are included on graphs for comparison purposes only and were not used to estimate parameter values for the lumped-parameter models

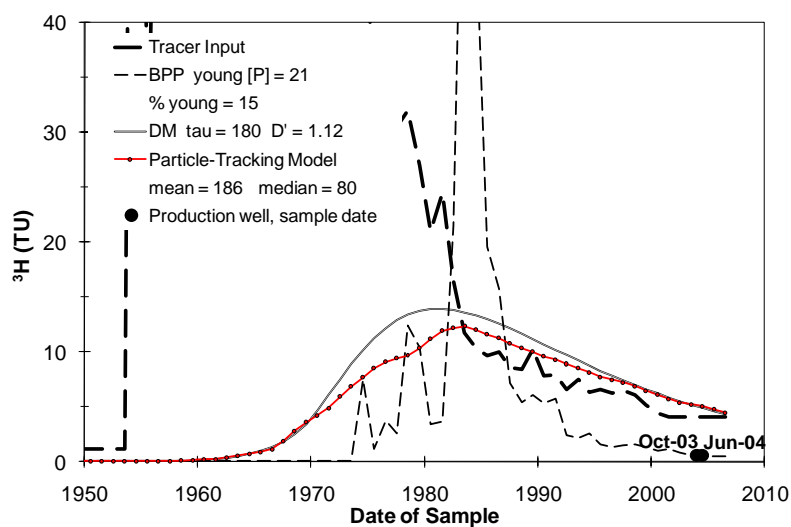


Fig. ESM8 Tracer-time graphs for the York, Nebraska, production well completed in layered, confined unconsolidated sediments. Individual curves correspond to different models, where BPP is binary piston flow and tracer-free mix, DM is dispersion, and Particle-Tracking Model is three-dimensional groundwater-flow model with particle tracking (symbols explained in top graph)

